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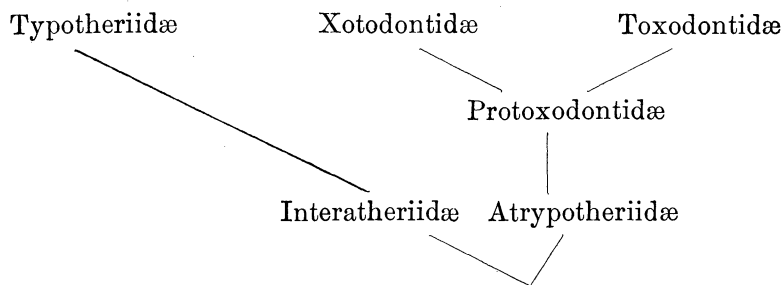
TOXODONTIA.

BY E. D. COPE.

In this order of Ungulates the carpus is partly diplarthrous, while the tarsus is taxeopodous. The carpus is quite like that of the Amblypoda, the scaphoid bone not extending external to the trapezoides, while the lunar has a well-marked articulation with the unciform. The tarsus, on the other hand, is like that of the Taxeopoda in general, but adheres strictly to the Ungulate type in the truncate and non-moveable articulation of the astragalus with the succeeding element, the navicular. The unguis vary from broadly to narrowly ungulate; as in *Toxodon* they resemble those of a rhinoceros, and in *Tytopotherium* those of some of the subungulate Glires, as the *Capybara*. The known members of the order are plantigrade, or nearly so. In all of them the fibula articulates with the calcaneum. In some of them there is no clavicle, while in others it is present. The dentition is lophodont, becoming ptychodont in some of the later forms; quadri- and tritubercular forms being unknown. In details the families and genera differ much among themselves. I therefore consider the further characters under the respective heads. I adopt the system of Ameghino, which seems to express their affinities very closely.

- I. Some or all of the molars rooted.
- A. Last inferior premolar at least with four roots.
Incisors with simple closed roots; *Atryphtheriidæ*.
- AA. Inferior premolar with two roots.
Incisors with simple closed roots, and no enamel;
Interatheriidæ.
- Several incisors with open roots and an anterior enamel band as in the Glires; other incisors with closed roots;
Protoxodontidæ.
- II. Molar teeth with simple open roots.
- A. Inferior molars curved outwards.
Enamel covered by cement; *Typotheriidæ*.
Enamel exposed; *Xotodontidæ*.
- AA. Inferior molars curved inwards.
Enamel not covered by cement; *Toxodontiidæ*.

The skeleton is best known in the typical genera of the families *Typotheriidæ* and *Toxodontidæ*. In *Typotherium* there is a clavicle, and the femur has a third trochanter. The sacrum is elongate, including nine vertebræ, and the ischium articulates with the posterior of these, as the ilium does with the anterior. In *Toxodon* there is no clavicle, the femur has no third trochanter, and the ilium only articulates with the sacrum, which consists of five vertebræ. In both genera there is a central bone of the carpus. According to Ameghino, the families with rooted molars are of prior geologic age to those with the prismatic type with open roots. This succession is parallel to the history of the families of the Glires and the *Diplarthra*. The following table of affinities and phylogeny is given by Ameghino:—



The molar teeth in this order are furnished with enamel over the summit of the crown, and in bands on its shaft, when present. In the superior molars there is a longitudinal exterior wall, and from one to three more or less oblique transverse crests running inwards from it, when the crowns are not entirely simple. The summit of the crown is soon worn away and the tooth then displays the pattern of a transverse section. The inferior molars are much narrower than the superior, and have several lobes on the internal side (in section). The incisors are more or less specialized towards gliriform types in the later genera. The canines are always small when present.

There are but two certainly known genera of *ATRYPTHERIIDÆ*, which differ as follows:—

- Pm. $\frac{1}{4}$ with four roots; two molars with open roots; an inferior canine; *Atryptherium* Amegh.
 Pm. $\frac{3}{4}$ and $\frac{1}{4}$ and m. $\frac{1}{1}$ with four roots; m. $\frac{3}{4}$ and m. $\frac{1}{4}$ with open roots; no inferior canine; *Scopotherium* Amegh.

Each of the above genera contained but a single species of about the size of a tapir, from the Eocene beds of Patagonia. The genus *Nesodon* Owen from the same region and horizon may be identical with *Scopotherium*, according to Ameghino, but the structure of the roots of the inferior molar is unknown. Two species are known, *N. ovinus*, the size of a sheep, and *N. imbricatus* Ow. as large as a tapir. In all of these forms the incisors are not much specialized, but are subequal.

In the *INTERATHERIIDÆ* the incisors are still unspecialized in the gliriform direction, and their roots are conic and closed. The four genera differ as follows:—

- I. Pms. $\frac{2}{2}$ and $\frac{3}{3}$ with distinct roots. Incisors diminishing in size externally; *Interatherium* Moreno.
 II. All molars rootless and open.
 Pm. $\frac{3}{3}$ and $\frac{1}{4}$ consisting of two subequal columns; incisors diminishing outwards; *Icochilus* Amegh.
 Pm. $\frac{3}{3}$ and $\frac{1}{4}$ of two columns, the anterior much larger than the posterior; external incisor with expanded crown, which is bilobate on the internal side; *Protypotherium* Amegh.

Like *Protypotherium*, but all the inferior incisors with expanded crown, which is bilobate on the internal side;

Patriarchus Amegh.

All the genera and most of the species of this family have been derived from the Eocene beds of Patagonia. One species of *Protypotherium* has been found in the Oligocene of the same region, and another species of the same genus in the Miocene of Buenos Ayres.

There are two species of *Interatherium* which were about the dimensions of hares and rabbits. The four species of *Icochilus* and the five of *Protypotherium* ranged from the size of our *Lepus silvaticus* up to that of a fisher weasel or a little larger. The single *Patriarchus*, *P. paluridens* Amegh., rather exceeded the latter animal. Its incisor teeth are peculiar in their expanded crowns, with a deep longitudinal groove on the internal side.

The genera and species of the *PROTOXODONTIDÆ* are all from the Eocene beds of Patagonia, with one uncertain exception. The former differ as follows, according to Ameghino:—

I. Molars with base more or less rooted, and with crown with unequal lobes.

α Superior incisors regularly diminishing outwards.

Molars with imperfect roots and open base;

Adelpotherium Amegh.

αα Second incisor largest and with open base; I. 3 rudimental or small.

β I. 1 present.

Eight superior molars;

Acrotherium Amegh.

Superior molars 7; first inferior premolar one-rooted;

Adinotherium Amegh.

Superior molars 7; Pm. ¹ and ² one-rooted;

Protoxodon Amegh.

β β I. 1 wanting.

I. ² triangular in section;

Phoberotherium Amegh.

II. Inferior molars rooted and with opposite lateral grooves.

Anterior column of molars smaller than posterior;

Calpodon Burm.

III. Inferior molars rootless and with open base, and with opposite lateral grooves. Anterior columns smaller than posterior; shaft curved inwards; *Gronotherium* Amegh.

Where the feet are known in this family, they exhibit three digits anteriorly and three posteriorly, which is remarkable in genera of such early age (*Acrotherium*, *Adinotherium* and *Protoxodon*). The possession of eight molars by *Acrotherium* is a remarkable fact, and one which reminds us of the *Sirenia*, to which Owen thought the *Toxodontia* to be allied. Ameghino regards them as representing five premolars and three true molars.

The species of the above genera were of various dimensions, but generally exceeded those of the *Interatheriidae*. The smallest is the *Colpodon limitatum* Amegh., which does not exceed a rabbit, but other species equaled deer in dimensions, and the *Protoxodon sullivanii* of Owen and *Acrotherium rusticum* Amegh. reached the size of the ox.

In the increased development of the second incisor an approach to the *Toxodontidae* is seen, and the same tendency is exhibited in the open rooted and incurved crowns of the true molars in *Gronotherium*. Fifteen species of the family are known, of which four belong to *Protoxodon* and five to *Adinotherium*.

Taking up another line of departure from the *Interatheriidae*, we reach the *TYPOTHERIIDÆ*, one of the two principal types by which the order *Toxodontia* was represented at the time of its extinction at the end of the Pliocene. We find here a great specialization of the first incisors in both jaws, and a gradual extinction of the third and second, so that in *Typotherium* this part of the dentition is decidedly gliriform, so much so that some authors have placed this family in the order *Glires*. In the oldest genus (*Hegetotherium* Amegh.) the molars are simple and of oval section, while in the latest forms they are lophodont with an external longitudinal and internal transverse crests, as in most other forms of the order. The genera differ as follows:—

I. Superior molars without folds or columns.

Incisors $\frac{3}{3}$; molars $\frac{7}{7}$

Hegetotherium Amegh.

Incisors $\frac{1}{2}$; molars $\frac{6}{8}$;

Pachyrhucus Amegh.

II. Superior molars with three internal lobes.

Incisors $\frac{3}{4}$; molars $\frac{5}{8}$;

Trachytherus Amegh.

Incisors $\frac{1}{3}$; molars $\frac{5}{4}$;

Entelomorphus Amegh.

Incisors $\frac{1}{2}$; molars $\frac{5}{4}$;

Mesotherium Serres.

These genera are distributed as follows:—

Hegetotherium: two species from the Lower Eocene.

Pachyrhucus: five species Lower Eocene, four species Miocene, one species Inferior Pliocene.

Trachytherus: one species Lower Eocene.

Entelomorphus: One species Inferior Pliocene.

Mesotherium: four species Upper Miocene, four species Lower Pliocene, three of them found also in the Upper Miocene.

A clavicle is present in *Pachyrhucus* and *Mesotherium*, and may be expected to be discovered in the other genera of this family. The dental canal sends out a branch which issues from the ramus posteriorly on the external side. According to Ameghino this character is not present in other families of the Toxodontia.

Most of the species were of small or medium size, and probably resembled the conies in their appearance and habits. *Mesotherium cristatum* Serres, and *Trachytherus spegazzianus* Amegh. reached the size of the tapir.

In the XOTODONTIDÆ of Ameghino we have a family which presents characters of both the families Mesotheriidæ and Toxodontidæ. As in the former, the inferior molars turn outwards below, but they are not covered with cementum as in that family. The known genera have the dental series uninterrupted, thus displaying a more primitive character than most of those of the two families mentioned.

The genera are as follows:—

I. Incisors entirely covered with enamel. Incisors and molars with open base; latter not plicate; *Entomodus* Amegh.

II. Incisors with enamel bands only.

α Molars $\frac{1}{1}$ and $\frac{2}{2}$ trilobate internally and bilobate externally.

All inferior premolars curved outwards; *Xotodon* Amegh.

Inferior molars turned inwards and true molars turned outwards ; *Stenostrephanus* Amegh.

$\alpha\alpha$ Molars $\frac{1}{1}$ and $\frac{2}{2}$ bilobate externally and internally. M. $\frac{3}{3}$ trilobate on internal side, *Lithops* Amegh.

Of the six species of this family one of *Lithops* and one of *Stenostrephanus* are from the Lower Eocene of Patagonia ; and one of *Entomodus*, one of *Xotodon* and one of *Stenostrephanus* are from the Lower Miocene of the same region ; and one species of *Xotodon* is from the Upper Miocene of Buenos Ayres.

The TOXODONTIDÆ includes the latest of one of the two lines of descent of this order. The genera differ in the forms of the molar teeth, and some of them show a decided simplification of structure which must be regarded as a degeneracy. Most of the species are of large size. Toes three, both in front and behind. The genera differ as follows :—

I. Seven superior molars.

Superior molars with internal groove and column of moderate size ; *Toxodon* Owen.

Superior molars with internal groove and very large internal column ; *Toxodontotherium* Amegh.

Superior molars without internal groove or column ; *Haplodontotherium* Amegh.

II. Six superior molars.

Pm. $\frac{4}{4}$ and true molars with two internal grooves ; *Dilobodon* Amegh.

Pm. all simple ; m. with one internal groove ; *Trigonodon* Amegh.

Seventeen species of this family have been determined up to the present time, eleven of which belong to the genus *Toxodon*. Two species each are referred to *Toxodontotherium* and *Dilobodon*, and one each to the two remaining genera. The geological distribution of these species is as follows :—

	Oligocene.	Miocene.	Pliocene.
<i>Toxodon</i> ,	3	1	7
<i>Toxodontotherium</i> ,	1		
<i>Haplodontotherium</i> ,	2		
<i>Dilobodon</i> ,	1		1
<i>Trigonodon</i> ,		1	
	<hr/> 7	<hr/> 2	<hr/> 8

The incisor teeth display an increased specialization in the genera commencing with *Trigonodon* and ending with *Toxodon*. The dental formula in *Toxodon* is I. $\frac{3}{3}$; C. $\frac{0}{1}$; Pm. $\frac{4}{3}$; M. $\frac{3}{3}$; in *Trigonodon* it is I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{3}{3}$; M. $\frac{3}{3}$. In *Trigonodon* the median (1^2) incisors are smaller and have closed roots, while the external is large and has open roots. In *Toxodon* the I. $\frac{1}{1}$ has disappeared, and the I. $\frac{2}{2}$ is extended transversely and has an open root. The I. $\frac{2}{2}$ is narrower and more elongate and has an open root. The species of *Toxodon* differ as to the transverse extent of the I. $\frac{2}{2}$; it being wider in the *T. burmeisteri* Gieb. than in the typical species, *T. platensis* Owen, and widest in the *T. expansidens* Cope from Brazil.

The skull of *Toxodon* is wide and elevated posteriorly and narrow anteriorly. The occiput slopes anteriorly and is notched on each side by a large mastoid foramen, somewhat as in the *Sirenia*. The nostrils have a posterior position. For these reasons it has been suspected that there may be some affinity between the *Toxodontia* and the *Sirenia*.

The species of *Toxodon* were, according to Ameghino, heavy animals with rather short legs, the anterior the shorter. He imagines that they were shore dwellers or semi-aquatic, in some degree like the Hippopotamus in their habits. The *T. platensis* Ow. is about the size of the *Rhinocerus unicornis*; the *T. burmeisteri* is somewhat larger, while the *T. ensenadensis* is of still larger dimensions. The *Toxodontotherium compressum* Amegh. was of about the size of the typical *Toxodons*, while the species of the other genera of the family are of successively smaller size, those of *Dilobodon* being the least.